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| 10/686,342 | 10/14/2003 | Randal W. Chance | MI22-2387 | 7186 |

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| EXAMINER |
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ROSASCO, STEPHEN D

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| ART UNIT | PAPER NUMBER |
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1756

DATE MAILED: 10/17/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/686,342

Applicant(s)

CHANCE ET AL.

Examiner

Stephen Rosasco

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 03 October 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-51 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-51 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

Detailed Action

In response to the Remarks of 10/03/05 the examiner withdraws the prior office action rejections and includes new rejections here over newly cited art.

Claim 1 is rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The use of the phrase "suitable for attenuation" in the claim is unclear. The claim is to a method of converting a reticle by reducing a portion of the substrate, wherein it becomes suitable for phase shifting and attenuation at a longer wavelength. The reduction in the substrate is known to affect the phase shift, however, it is unclear if anything has been done to the mask to change its attenuation at the longer wavelength.

Also it can be viewed as intended use for the article that is produced, which is a limitation that is not considered in the examination process.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

Claims 1-51 are rejected under 35 U.S.C. 102(b) as being anticipated by Vasudev (5,480,747).

The claimed invention is directed to a method of converting a reticle from a first configuration suitable for a shorter wavelength of radiation to a second configuration suitable for a longer wavelength

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of radiation, comprising: providing the reticle in the first configuration suitable for the shorter wavelength of radiation, the first configuration reticle comprising a substrate material and a patterned material over the substrate material, the patterned material overlapping first regions of the substrate material and not overlapping second regions of the substrate material, the patterned material having a lower absolute transmission of the shorter wavelength of radiation than the substrate material, the shorter wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate material; and while protecting the first regions of the substrate with at least the patterned material, reducing the thickness of the second regions of the substrate material; after the reduction in thickness, the longer wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate.

Vasudev et al. teach an attenuated phase shifting photolithography mask for use in projecting an image pattern onto a target comprising: a mask substrate formed from a substantially transparent material for permitting light transmission therethrough, said substrate having trenches on its surface corresponding to non-phase shifting regions and wherein said trenches have a depth corresponding to a set distance d_{sub2} ;

an absorber pattern formed from a light absorbing material and buried at a distance d_{sub1} from said substrate surface, in which said distance d_{sub1} is greater than said set distance d_{sub2} , and disposed below said surface of said substrate at phase shifting regions and not adjacent to said surface;

said absorber pattern for absorbing a significant portion of light transmission there through to form an attenuator pattern in said substrate, such that light attenuation is obtained from said light absorbing material and phase shifting is determined by a combination of said light absorbing material and trench depth d_{sub2} ;

wherein having said attenuator pattern buried below said surface of said substrate but not adjacent to said surface, allows for light scattering at said attenuator pattern to be reflected back into said substrate at a surface interface of said substrate, in order to improve image feature definition; and

wherein having said attenuator pattern buried below said surface at said distance d.sub.1 is of sufficient depth in order to provide for a maximum depth of focus of an exposure system being utilized to reside within said substrate, such that surface defects and contaminants at said surface interface are not imaged on to said target.

And wherein said attenuator pattern has a thickness to attenuate approximately 85-95% of light transmitting there through.

Vasudev et al. also teach the method of fabricating an attenuated phase shifting photolithography mask for use in projecting an image onto a target, comprising the steps of:

forming a photoresistive layer over a mask substrate;

patterning said photoresistive layer to expose portions of said substrate underlying said photoresistive layer;

etching said exposed portions of said substrate to a predefined depth to form trenches in said substrate;

removing remaining portions of said photoresistive layer; depositing a layer of light absorbing material over said substrate and filling said trenches;

selectively etching back said layer of light absorbing material until only said trenches are filled with said light absorbing material;

wherein said absorbing material forms an attenuator pattern below said surface of said mask and not adjacent to said surface, such that light attenuation is obtained from said light

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absorbing material and an amount of phase shifting is obtained from said light absorbing material at a set wavelength of transmitted light;

The use of the phrase "suitable for attenuation" in the claim is unclear. The claim is to a method of converting a reticle by reducing a portion of the substrate, wherein it becomes suitable for phase shifting and attenuation at a longer wavelength. The reduction in the substrate is known to affect the phase shift, however, it is unclear if anything has been done to the mask to change its attenuation at the longer wavelength.

Also it can be viewed as intended use for the article that is produced, which is a limitation that is not considered in the examination process.

The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

Claim 1 is rejected under 35 U.S.C. 102(e) as being anticipated by Babcock et al. (6,902,851) or Ghandehari et al. (6,500,587).

Babcock et al. teach a method of testing the effect of lights having different wavelengths on a layer of photoresist, comprising: providing a phase-shifting mask having a transparent material having first and second trenches, the first trench having a first depth and the second trench having a second depth deeper than the first depth; transmitting light having a first wavelength through the first trench to the photoresist layer such that the light having a first

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wavelength is phase-shifted; transmitting light having a second wavelength longer than the first wavelength through the second trench to the photoresist layer such that the light having a second wavelength is phase-shifted; and comparing an effect on the photoresist layer of the light having the first wavelength to an effect on the photoresist layer of the light having the second wavelength.

And wherein the first depth is suitable for phase-shifting light having the wavelength of 248 nm by 180 degrees.

And wherein the first depth is suitable for phase-shifting light having a wavelength of 193 nm.

Ghandehari et al. teach a method of using a dual layer feature on a mask in an integrated circuit fabrication process to provide for use of the mask at multiple wavelengths, the method comprising: providing a dual layer feature over a mask, the dual layer feature being configured with layers of selected thicknesses which allow the mask to be used at multiple wavelengths; and subjecting the dual layer feature and the mask to a beam at one of the multiple wavelengths.

Ghandehari et al. also teach the mask used with multiple wavelengths of 157 nm and 193 nm, or multiple wavelengths include 157 nm, 193 nm, and 248 nm.

Ghandehari et al. also teach the use of an absorber material to adjust the transmission of the light.

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill

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in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 1-51 are rejected under 35 U.S.C. 103(a) as being unpatentable over Babcock et al. (6,902,851) or Ghandehari et al. (6,500,587) in view of Vasudev (5,480,747).

The claimed invention is directed to a method of converting a reticle from a first configuration suitable for a shorter wavelength of radiation to a second configuration suitable for a longer wavelength of radiation, comprising: providing the reticle in the first configuration suitable for the shorter wavelength of radiation, the first configuration reticle comprising a substrate material and a patterned material over the substrate material, the patterned material overlapping first regions of the substrate material and not overlapping second regions of the substrate material, the patterned material having a lower absolute transmission of the shorter wavelength of radiation than the substrate material, the shorter wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate material; and while protecting the first regions of the substrate with at least the patterned material, reducing the thickness of the second regions of the substrate material; after the reduction in thickness, the longer wavelength of radiation being shifted substantially out of phase upon passing through the combined thicknesses of the patterned material and first regions of the substrate material relative to passing through the thickness of the second regions of the substrate.

FIG. 9 shows construction 100 after the construction has been exposed to an etch which reduces a thickness of second portions 104 of substrate 12. If the exposed surface of substrate 12 comprises, consists essentially of, or consists of quartz, a suitable etch can be a dry etch utilizing, for example, C₂F₆. The quartz etch can be a timed etch, with a typical time for an exemplary application in which about 600 ANG of quartz is removed being from about 74 seconds to about 77 seconds.

An advantage of leaving chromium-containing layer 16 over material 14 during the etch of substrate 12 is that is frequently easier to selectively etch the material of substrate 12 relative to

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chromium-containing material 16 than it would be to selectively etch the material of substrate 12 relative to masking material 14. In the shown aspect of the invention, the substrate 12 has about the same thickness in first regions 102 relative to second regions 104 prior to the etch, and after the etch has significantly different thicknesses in first regions 102 relative to second regions 104. Substrate 12 will commonly have a thickness of about 250 mils (0.250 inches), and the etch of second regions 104 will frequently reduce a thickness of such second regions by about 600 ANG in applications in which construction 100 is initially configured for utilization with 193 nanometer wavelength radiation and is to be converted to a configuration suitable for utilization with 248 nanometer wavelength radiation.

Babcock et al. and Ghandehari et al. are included here as described above.

The teachings of Babcock et al. and Ghandehari et al. differ from those of the applicant in that they do not teach the use of attenuation.

Vasudev et al. is included here as described above.

It would have been obvious to one having ordinary skill in the art to take the teachings of Babcock et al. and Ghandehari et al. and combine them with the teachings of Vasudev et al. in order to make the claimed invention because the primary references teach that etching of a substrate to adjust the phase shift at different wavelengths, the use of attenuated phase shifting and its resulting pattern are well known in the art, and it would have been obvious to one to adjust the amount of light transmitted in conjunction with the phase shifting to produce the desired resulting pattern.

Applicant's arguments with respect to claims 1-51 have been considered but are moot in view of the new ground(s) of rejection.

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Conclusion

Any inquiry concerning this communication or earlier communications from the Examiner should be directed to Stephen Rosasco whose telephone number is (571) 272-1389. The Examiner can normally be reached Monday-Friday, from 8:00 AM to 4:30 PM. The Examiner's supervisor, Mark Huff, can be reached on (571) 272-1385. The fax phone number for the organization where this application or proceeding is assigned is (571) 273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

A handwritten signature in black ink, appearing to read 'S. Rosasco', with a stylized, flowing script.

S. Rosasco
Primary Examiner
Art Unit 1756

S. Rosasco
10/13/05